AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application.

LISTING OF CLAIMS:

Claims 1-31: (canceled)

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Claim 32. (previously presented) A process for electrochemical deposition of metal onto a surface of a microelectronic workpiece, comprising:

exposing a surface of the microelectronic workpiece to a plating solution including a principal metal species to be deposited;

applying plating power between the surface of the workpiece and an electrode disposed in contact with the plating solution to electrolytically deposit metal onto the surface, wherein plating power is applied;

at a first current density for a first period of time to deposit a first layer of the metal onto the surface of the workpiece; and subsequently

at a second current density for a second period of time to deposit a second layer of the metal onto the first layer of metal, wherein the second current density is substantially greater than the first current density and a majority of the metal deposited onto the surface of the workpiece is deposited during the second time period.

Claim 33. (previously presented) The process of claim 32, wherein the surface of the microelectronic workpiece defines a plurality of recessed microstructure, and the first current density and first period of time are selected to at least partially fill the recessed microstructures with the deposited metal.

Claim 34. (previously presented) The process of Claim 33, wherein metal deposited during the first time period has a grain size that is sufficiently small to fill the recessed microstructures and at least some of the recessed microstructures have a width of less than or equal to 0.3 micron.

Claim 35. (previously presented) The process of Claim 33, further comprising annealing the deposited metal after the second time period to increase a grain size defined by the metal.

Claim 36. (previously presented) The process of Claim 35, wherein the metal is annealed at a temperature of less than 250°C.

Claim 37. (previously presented) the process of Claim 32, wherein the first current density is about 3.2 mA/cm^2.

Claim 38. (previously presented) The process of Claim 32, wherein the second current density is about 20 ma/ cm^2.

Claim 39. (previously presented) The process of Claim 32, wherein a ratio of the second current density to the first current density is about 6:1.

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Claim 40. (previously presented) The process of Claim 32, wherein the first time period is about 30 seconds.

Claim 41. (previously presented) The process of Claim 32, further comprising annealing the deposited metal after the second time period at a temperature of less than 250°C.

Claim 42. (previously presented) The process of Claim 32, wherein metal is deposited at a higher rate during the second time period than during the first time period.

Claim 43. (previously presented) The process of Claim 32, further comprising depositing a seed layer onto the surface of the microelectronic workpiece prior to the first time period, the first layer of metal being deposited onto the seed layer.

Claim 44. (previously presented) A process for electrochemical deposition of copper onto a surface of a microelectronic workpiece, comprising:

exposing a surface of the microelectronic workpiece to a plating solution including copper as a principal metal species to be deposited;

applying plating power between the surface of the workpiece and an electrode disposed in contact with the plating solution to electrolytically deposit copper onto the surface, wherein plating power is applied:

at a first current density for a first period of time to deposit a first layer of copper onto the surface of the workpiece; and subsequently\

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at a second current density for a second period of time to deposit a second layer of copper onto the first layer of copper, wherein the second current density is substantially greater than the first current density and a majority of copper deposited onto the surface of the workpiece is deposited during the second time period.

Claim 45. (previously presented) The process of Claim 44, wherein the second current density is applied immediately after the first period of time.

Claim 46. (previously presented) A process for electrochemical deposition of metal onto a surface of a microelectronic workpiece, the surface defining a plurality of recessed microstructures, comprising:

exposing a surface of the microelectronic workpiece to a plating solution including a principal metal species to be deposited;

applying plating power between the surface of the workpiece and an electrode disposed in contact with the plating solution to electrolytically deposit metal onto the surface, wherein plating power is applied:

at a first current density for a first period of time to deposit a first layer of the metal onto the surface of the workpiece to at least partially fill the recessed microstructures; and subsequently

at a second current density for a second period of time to deposit a second layer of the metal onto the first layer of metal, wherein the second current density is substantially greater than the first current density.

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Claim 47. (previously presented) The process of Claim 46, wherein the second current density is applied immediately after the first period of time has elapsed.

Claim 48. (previously presented) A process for electrochemical deposition of metal onto a surface of a microelectronic workpiece, comprising:

applying a metal seed layer onto a surface of the microelectronic workpiece;

exposing the surface of the microelectronic workpiece to a plating solution including a principal metal species to be deposited;

applying plating power between the surface of the workpiece and an anode disposed in contact with the plating solution to electrolytically deposit metal onto the surface, wherein plating power is applied:

at a first current density for a first period of time to deposit a first layer of the metal onto the seed layer on the surface of the workpiece; and subsequently

at a second current density for a second period of time to deposit a second layer of the metal onto the first layer of metal, wherein the second current density is substantially greater than the first current density.

Claim 49. (previously presented) A method of depositing a metal layer on a semiconductor wafer, comprising:

depositing a seed layer on a surface of the wafer;

immersing the wafer in an electrolytic solution containing metal ions;

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electrolytically depositing a first plated layer on the wafer by applying current at a first current density between the wafer and the solution; and

after a first period of time during which the first plated layer has been formed, increasing the applied current to a second current density greater than the first current density to plate additional metal onto the first plated layer.

Claim 50. (previously presented) An apparatus for use in electrochemical deposition of metal onto a surface of a microelectronic workpiece, comprising:

a reactor that receives a surface of the microelectronic workpiece in a chamber in which the surface of the microelectronic workpiece is exposed to a plating solution including a principal metal species to be deposited;

an electrode disposed in contact with the plating solution; and

a source of plating power supplied between the anode and the surface of the microelectronic workpiece to deposit metal from the plating solution onto the surface of the microelectronic workpiece, wherein the source of plating power is operated to supply power at a first current density for a first period of time to deposit a first layer of metal onto the surface of the workpiece, and then at a second current density for a second period of time to deposit a second layer of metal onto the first layer of metal, and wherein the second current density is substantially greater than the first current density and the majority of metal is deposited onto the surface of the workpiece during the second time period.

Claim 51. (previously presented) An apparatus for use in electrochemical deposition of metal onto a surface of a microelectronic workpiece including recessed microstructures, comprising:

a reactor that receives a surface of the microelectronic workpiece in a chamber in which the surface of the microelectronic workpiece is exposed to a plating solution including a principal metal species to be deposited;

an electrode disposed in contact with the plating solution; and

a source of plating power connected between the anode and the surface of the microelectronic workpiece to deposit metal from the plating solution onto the surface of the microelectronic workpiece to at least partially fill the recessed microstructures, wherein the source of plating power supplies power at a first current density for a first period of time to deposit a first layer of metal onto the surface of the workpiece, and subsequently supplies power at a second current density for a second period of time to deposit a second layer of metal onto the first layer of metal, and wherein the second current density is substantially greater than the first current density.

Claim 52. (previously presented) An apparatus for use in electrochemical deposition of metal onto a surface of a microelectronic workpiece, comprising:

reactor means for receiving a surface of the microelectronic workpiece in a chamber in which the surface of the microelectronic workpiece is exposed to a plating solution including a principal metal species to be deposited;

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an electrode disposed in contact with the plating solution; and

means for supplying plating power between the anode and the surface of the microelectronic workpiece to deposit metal from the plating solution onto the surface of the microelectronic workpiece, wherein the means for supplying plating power supplies power at a first current density for a first period of time to deposit a first layer of metal onto the surface of the workpiece, and subsequently supplies power at a second current density for a second period of time to deposit a second layer of metal onto the first layer of metal, and wherein the second current density is substantially greater than the first current density and the majority of metal is deposited onto the surface of the workpiece during the second time period.

Claim 53. (previously presented) A process for electrochemical deposition of material onto a surface of a microelectronic workpiece, comprising:

exposing a surface of the microelectronic workpiece to a solution including a material to be deposited;

applying plating power between the surface of the workpiece and an electrode disposed in contact with the solution to be electrolytically deposit material onto the surface, wherein plating power is applied:

at a first current density for a first period of time to deposit a first layer of the material onto the surface of the workpiece; and subsequently

at a second current density for a second period of time to deposit a second layer of the material onto the first layer of material, wherein the second current density is substantially greater than the first

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current density and a majority of the material deposited onto the surface of the workpiece is deposited during the second time period.

Claim 54. (previously presented) A method of depositing a metal layer on a semiconductor wafer comprising:

depositing a seed layer on a surface of the wafer;

immersing the wafer in an electrolytic solution containing metal ions;

biasing the wafer negatively with respect to the electrolytic solution so as to create a current flow at a first current density between the electrolytic solution and the wafer and thereby deposit a plated layer electrolytically on the wafer; and

after a combined thickness of the seed and plated layers has reached a predetermined value, increasing the current flow to a second current density greater than the first current density.

Claim 55. (previously presented) The method of claim 54 wherein the plated and seed layers include copper.

Claim 56. (currently amended) The method of claim ~~542~~ 54 wherein a top surface of the semiconductor wafer includes features to be filled with metal and the method includes applying a current flow at a third current density such that features are filled with metal.

Claim 57. (previously presented) The method of depositing a metal layer on a semiconductor wafer comprising:

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immersing a wafer having a seed layer on the surface thereof in an electrolytic solution containing metal ions;

biasing the wafer negatively with respect to the electrolytic solution so as to create a current flow at a first current density between the electrolytic solution and the wafer and thereby deposit a plated layer electrolytically on the wafer; and

after a predetermined time, increasing the current flow to a second current density greater than the first current density.

Claim 58. (previously presented) The method of depositing a metal layer on a semiconductor wafer comprising:

contacting the wafer with a electrolytic solution containing metal ions;

applying a plating current to the wafer so as to create a current flow at a first current density between the electrolytic solution and the wafer and thereby deposit a plated layer electrolytically on the wafer; and

after a combined thickness of the seed and plated layers has reached a predetermined value, increasing the current flow to a second current density greater than the first current density.

Claim 59. (previously presented) The method of depositing a metal layer on a semiconductor wafer comprising:

depositing a seed layer on the surface of the wafer;

contacting the wafer with a electrolytic solution containing metal ions;

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applying a plating current to the wafer so as to create a current flow at a first current density between the electrolytic solution and the wafer and thereby deposit a plated layer electrolytically on the wafer;

after a predetermined time, increasing the current flow to a second current density greater than the first current density.

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